

A SIMPLE PHYSICAL OPTICS ALGORITHM PERFECT FOR PARALLEL COMPUTING ARCHITECTURE

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One of the simplest reflector antenna computer programs is based upon a discrete approximation of the radiation integral. This calculation replaces the actual reflector surface with a triangular facet representation so that the reflector resembles a geodesic dome. The Physical Optics (PO) current is assumed to be constant in magnitude and phase over each facet so the radiation integral is reduced to a simple summation. This program has proven to be surprisingly robust and useful for the analysis of arbitrary reflectors, particularly when the near-field is desired and surface derivatives are not known.

Because of its simplicity, the algorithm has proven to be extremely easy to adapt to the parallel computing architecture of a modest number of large-grain computing elements such as are used in the Intel iPSC and Touchstone Delta parallel machines.

For generality, we consider a dual-reflector calculation, which can be thought of as three sequential operations: 1) compute the currents on the first reflector using the standard PO approximation; 2) utilizing the currents on the first reflector as the field generator, compute the currents on the second reflector; and 3) compute the required field values by summing the fields from the currents on the second reflector. The most time-consuming part of the calculation is the computation of the currents on the second reflector due to the currents on the first, since for $N \times N$ triangles on the first reflector each of the $M \times M$ triangles on the second reflector required an N^2 sum over the first. However, since each calculation requires the identical number of operations, the N^2 triangles can be evenly distributed over the nodes, and the sum done in parallel for each of the M^2 triangles on the second reflector (also evenly distributed over the nodes). In addition, the output field values can be calculated in parallel with each node, summing its respective triangles, and the final output field obtained by summing the field in each of the nodes,

For reasonable size reflectors, parallel efficiencies approaching 98% have been demonstrated.